SECTION 02510
WATER DISTRIBUTION SYSTEM

PART 1 - GENERAL

1.1 All piping, valves, fittings, fire hydrants, meters, meter vaults, appurtenances and other products shall conform to the requirements of ~~the latest NFPA regulations~~ **NFPA 13-2007 and NFPA 22-2003**, where applicable.

1.2 Quality Assurance

A. Comply with all applicable codes and regulations as required by regulatory agencies having jurisdictions over this Work.

1.3 Connections to existing system:

A. The Contractor shall make connections to the existing system under a pressure condition, complying with the system owner's requirements for the time of day such work can be done.

1.4 Contractor shall submit for approval dimensioned layout drawings for all flanged ductile iron pipe. Drawings shall include all fittings, valves, equipment, taps, appurtenances, and dimensions to locate pipe in buildings.

1.5 Exposed pipe shall be installed level, plumb and square to building walls and equipment in accordance with industry standards and practices.

PART 2 - PRODUCTS

2.1 All pipe, fittings, restraint devices, valves, etc. for piping systems shall be listed for fire service use (except where expressly prohibited by the water authority).

2.2 Underground Pipe and fittings

A. Ductile Iron Pipe:

1. Ductile iron pipe shall meet the requirements of AWWA C151, AWWA C150 and Rubber-gasket joints shall meet the requirements of AWWA C111 3" through 24" pipe shall be, at a minimum, class 52 with a working pressure of 350 psi. Pipe shall have a single cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA C104. A minimum of 5% of the pipe furnished shall be gauged for roundness full length and so marked. Pressure class of pipe shall be increased if the specific installation warrants it.

B. Fittings

1. Ductile Iron Fittings

a) Fittings shall be ductile iron and shall be in accordance with AWWA C110 **or C153**. ~~No compact fittings are allowed~~. Pressure ratings shall be a minimum of 350 psi for fittings 24-inch and smaller and 250 psi for 30-inch. All fittings shall have a single cement mortar lining on the interior and a bituminous seal coating on the exterior. Fittings shall have mechanical joints conforming to the requirements of AWWA C111. Bolts for mechanical joint fittings shall be high strength, corrosion – resistant low alloy steel with hexagon nuts having a minimum yield point of 45,000 psi in accordance with AWWA C111. Mechanical joint bolts shall be torqued with a torque wrench as per manufacturer's recommendations.

C. Thrust Restraint

1. All pipe fittings, plugs, caps, tees, and bends in underground ductile iron or PVC piping must be restrained utilizing Megalug Series 1100 retainer glands by EBAA Iron

Sales, Inc. (or approved equal). Glands shall be manufactured of ductile iron conforming to ASTM A 536-80. Restraining devices shall be of ductile iron heat treated to a minimum hardness of 370 BHN. Dimensions of the gland shall be such that it can be used with the standardized mechanical joint bell and tee-head bolts conforming to ANSI/AWWA A21.11 and C153/A21.53. Twist-off nuts shall be used to insure proper actuating of the restraining devices. The mechanical joint restraint device shall have a working pressure of at least 250 psi with a minimum safety factor of 2.

D. Buried Copper Tubing

1. Copper tubing for underground services shall be seamless, annealed copper tubing Type K, in conformance with ASTM B88. Fittings shall be case bronze with flared joints.

E. Couplings for underground or buried service shall be ductile iron mechanical joint in accordance with underground ductile fittings in this section.

2.3 Above Ground or Exposed Piping

A. Ductile Iron Pipe

1. Ductile iron pipe installed above ground, inside buildings or underground vaults, shall be flanged ductile iron pipe class 53 in accordance with ANSI A21.15 (AWWA C115). Unless indicated otherwise on the drawings pipe shall have Class 125 flanged joints utilizing factory installed screwed flanges (no uniflange type flanges are permitted) meeting the requirements of ANSI B 16.1, outside coating shall be red primer, and gaskets for flanged pipe shall be 1/8” thick full face red rubber. All steel flanges mating to flat face flanges shall have the raised face machined off. Pipe shall have a single cement mortar lining with asphaltic seal coat meeting the requirements for AWWA C104.

B. Ductile Iron Fittings

1. Fittings for ductile iron pipe shall be flanged ductile iron in accordance with ANSI A21.10 (AWWA C110). Ductile iron compact fittings, in accordance with ANSI A21.53 (AWWA C153), may not be used unless specifically approved by the Engineer. Fittings up to 30” diameter shall have a minimum working pressure rating of 250 psi. Unless indicated otherwise on the drawings, pipe shall have Class 125 flanged joints meeting the requirements of ANSI B 16.1, outside coating shall be red primer, and gaskets for flanged pipe shall be 1/8” thick full face red rubber. Fittings shall have a single cement-mortar lining and a bituminous seal coat conforming to the requirement of AWWA C104.

C. Above Ground Copper Tubing

1. Copper tubing for exposed services shall be seamless, hard copper tubing Type L, in conformance with ASTM B88. Fittings shall be wrought copper with soldered joints. Solder shall be 95-5 approved for potable water service.

D. Couplings

1. Couplings for above ground or exposed service shall be Dresser Style 38 or approved equal. Transition couplings shall be Dresser Style 162 or approved equal. All couplings shall be rodded unless otherwise noted.

E. Flange adaptors

1. Flange adaptors shall be used where indicated on the drawings or as approved by the engineer. Flange adaptors may be used as a final connection or to allow for

disassembly of pipe for equipment maintenance in approved locations. Flange adaptors are not to be used to make up for misaligned pipe.

2. Flanged Adapter shall be JCM flanged coupling adaptors model 301R or approved equal.

2.4 Gate Valves

A. Gate valves 3" through 12" shall open counter-clockwise, have a resilient seat and meet the requirements of AWWA C509. Body shall be of cast iron with a 250 psig maximum working pressure and hydrostatically tested to 500 psig. Wedge shall be constructed of cast iron, bonded in synthetic rubber in accordance with ASTM D2000. Valve shall be coated inside and out with a fusion epoxy coating of a nominal 10 mil thickness on all exposed iron surfaces in compliance with AWWA C550 and is NSF 61 certified. Valves shall be bi-directional flow and have a ten year limited warranty.

1. Above ground valves or exposed valves in vaults shall utilize outside screw and yoke (OS&Y) with rising stems and have flanged ends meeting the requirements of ANSI B 16.1, Class 125.
2. Underground valves shall utilize non rising stems, mechanical joint ends with a 2" operating nut in accordance with AWWA C111.
3. Gate valves 3" and larger when located 6ft. or more above the finish floor or operating platform shall have chain operators.
4. Valves shall be Mueller series 2360, or approved equal.

B. Buried gate valves 2" in size shall utilize a non-rising stem, open counter-clockwise, resilient seat and meet the requirements of AWWA C509. Valve shall be equipped with a 2-inch square AWWA operating unit. Valve ends shall be NPT connections. Valves shall be Mueller series A-2360, or approved equal.

2.5 Ball Valves - Above Ground

A. Ball valves 2" and smaller shall be 150 lb rated, threaded ends, bronze or stainless steel body (stainless steel valves are to be used on stainless steel pipe), full port, lever operated, ball valves, with stainless steel ball and stem, and Teflon seats. Ball valves shall be Crane figure 9201 (bronze body), 9231(stainless steel) or approved equal.

2.6 Valve Boxes

A. Valve boxes for buried valves shall be cast iron, screw adjustable shaft boxes, with a minimum shaft diameter of 5-1/4 inches, unless otherwise specified on the Drawings. Valve box covers shall be marked with the word "WATER". Valves with valve boxes shall have an extended shaft pinned to the 2" operating nut and terminate 12" below finish grade. Valve box shall have a 24" x 24" x 4" concrete collar around top of valve box as per drawing detail.

2.7 Tamper Switches

A. All valves shall have tamper switches in accordance with NFPA 22 and 72. The signals for these switches shall be connected to the fire pump control panel located in the main building.

2.8 Pressure Gages

A. Pressure gauges shall be of all stainless steel construction, 3.5 inch case size, accuracy of 1% over the entire dial arch, ¼" NPT bottom connection, Pressure range shall be as indicated on the drawings.

B. Pressure gages shall be Ashcroft stainless steel–case 1009 pressure gauges or approved equal.

C. All pressure gages shall be installed with a ¼" stainless steel ball valve and stainless steel nipples.

D. All pressure gages shall be mounted with fittings or on fitting bosses. NO TAPPING OF PIPE OR SADDLES WILL BE ALLOWED.

2.9 Pipe Supports

A. Pipes shall be supported by steel pipe hangers, clamps. Brackets, rods and inserts as required to support the imposed pipe loads. Hangers in general shall be new, manufactured of carbon steel and hot dipped galvanized after fabrication or 304 stainless steel.

B. Pipes 2 ½ inches and larger shall be supported with adjustable floorstand type pipe supports as detailed on the drawings. Pipe supports shall be Standon Model S89 flange support, Standon Model S96 cradle support as manufactured by Material Resources, Inc. or approved equal.

C. Pipes 2" and smaller shall be supported from the floor, walls or ceiling depending on the type of building construction. Pipe supports for these size pipes shall be as manufactured by Unistrut Building Systems. Supports shall consist of floor stands, wall brackets or clevis type hangers. Unistrut and appurtenances shall be stainless steel. Clips for copper tubing's shall be copper coated. Minimum threaded rod size shall be 3/8 inch.

D. Ductile Iron and steel pipe supports shall be spaced in accordance with the following schedule:

Pipe sizes (inches)	½ - 3/4	1- 1 1/4	1 ½ - 2	3 – 4	6	8
Max spacing (feet)	4	6	8	10	12	14

E. Copper tubing pipe supports shall be spaced in accordance with the following schedule:

Nominal tubing size (inches)	½ - 3/4	1- 1 1/4	1 ½ - 2
Max spacing (feet)	4	6	8

F. Pipe supports shall be located as per the following:

1. Maximum spacing as indicated above
2. Maximum of 12 inches from all horizontal and vertical changes in direction.
3. On the suction and discharge of pump piping to eliminate pipe stresses on the pump flanges.
4. On the connections to all equipment to eliminate pipe stresses on the equipment connections and allow equipment removal.

5. On the inlet and outlet piping to the water meter to allow the removal of the water meter.

6. Additional pipe supports as indicated on the drawings.

PART 3 - EXECUTION

3.1 General

A. Water lines shall be laid to lines and grades shown on the drawings with appurtenances and service connections at required locations. Installation of all materials shall be in strict conformance with manufacturer's recommendations, AWWA standards, **NFPA 13-2007 and NFPA 22-2003 requirements.**

3.2 Separation of Water Lines and Sanitary and/or Combined Sewer

A. Follow State Health Department standards for separation of water mains and sewer lines.

B. Parallel Installation:

1. Normal Conditions Water lines shall be constructed at least 10 feet horizontally from a sewer or sewer manhole whenever possible. The distance shall be measured edge to edge.

2. Unusual Conditions When local conditions prevent a horizontal separation of at least 10 feet, the water line may be laid closer to a sewer or sewer manhole provided that:

a) The bottom of the water line is at least 18 inches above the top of the sewer.

b) Where this vertical separation cannot be obtained, the sewer shall be constructed of AWWA approved water pipe pressure tested in place to 50 psi without leakage prior to backfilling. The sewer manhole shall be of watertight construction and tested in place.

C. Crossing:

1. Normal Conditions: Water lines crossing over sewers shall be laid to provide a separation of at least 18 inches between the bottom of the water line and the top of the sewer whenever possible.

2. Unusual Conditions: When local conditions prevent the vertical separation described in crossing, normal conditions, (paragraph above) the following construction shall be used.

a) Sewers passing over or under water lines shall be constructed of the materials described in parallel installation, unusual conditions Paragraph b. above.

b) Water lines passing under sewers shall, in addition, be protected by providing:

i. A vertical separation of at least 18 inches between the bottom of the sewer and the top of the water lines.

ii. That the length of the water line shall be centered at the point of the crossing so that joints shall be equidistant and as far as possible from the sewer.

D. Sanitary and/or combined sewers or sewer manholes No water pipes shall pass through or come in contact with any part of sewer or sewer manhole.

3.3 Examination of Material:

A. All pipes, fittings, valves and other appurtenances shall be examined carefully for damage and other defects immediately before installation. Defective materials shall be marked and held for inspection by the Owner, who may prescribe corrective repairs or reject materials.

3.4 Pipe Ends:

A. All lumps, blisters, and excess coating shall be removed from the socket and plain ends of each pipe, and the outside of the plain end and the inside of the bell shall be wiped clean and dry and be free from dirt sand, grit, or any other foreign material before the joint is made. Proper lubricant shall be used for all push joint pipe.

3.5 Pipe Cleanliness:

A. Foreign material shall be prevented from entering the pipe while it is being placed in the trench. During laying operations, no debris, tools, clothing or other materials shall be placed in the pipe.

3.6 Pipe Placement:

A. Laying of the pipe shall be commenced immediately after the excavation is started, and every means must be used to keep pipe lying closely behind the trenching as each length of pipe is placed in the trench, the joint shall be assembled and the pipe brought to correct line and grade before the next length of pipe is laid. No more than 200 lf of trench shall be opened at any one time. No opened trenches will be allowed at the end of the work day.

B. Lay pipe with bell ends facing the direction of laying. Where grade is 10 percent or greater, lay pipe uphill with bell ends upgrade.

3.7 Pipe Plugs:

A. At times when pipe laying is not in progress, the open ends of the pipe shall be closed by a water tight plug or other means approved by the Engineer. When practical, the plug shall remain in place until the trench is pumped completely dry. Care must be taken to prevent pipe flotation should the trench fill with water.

3.8 Laying Conditions

A. Pipe shall be placed in a dry trench at the proper line and grade.

3.9 Pipe Deflection

A. Permissible deflection in mechanical joint pipe shall not be greater than 1/2 of that listed in AWWA C600 or as recommended by pipe manufacturer. No joint deflection shall be allowed in PVC pipe. Radius turn with PVC pipe shall be by bending pipe at 1/2 manufacturers recommended deflection.

3.10 Pipe Cutting:

A. Cutting of the pipe shall be done in a neat, workmanlike manner with the proper tools without creating damage to the pipe or cement mortar lining.

3.11 Restrained Joints

A. Provide reaction anchors of concrete blocking, metal harness, retainer gland type, restraining gaskets or restrained joint type pipe at all changes in direction of pressure pipelines and as shown on Drawings.

B. All mechanical joint bolts shall be torqued with a torque wrench as recommended by the manufacturer.

Bolt Size – Inches	Torque Ft. - Lbs.
5/8	45 - 60
3/4	75 - 90
1	100-120

C. Tighten nuts on alternate side of the gland until pressure on the gland is equally distributed

3.12 Manholes (at air release, valves, etc., as called for in the Drawings):

A. Manholes shall be constructed to the elevations shown on the Contract Drawings in accordance with the provisions of the Standard Details.

B. Set manhole base section on bed of VDOT #57 stone to a minimum depth of 8 in. Stone shall be thoroughly compacted and carefully leveled.

C. Join all manhole riser and cone or flat slab top sections by the use of o-ring type round rubber gaskets.

D. Install flexible manhole connections for all pipes sizes 4 in. to 24 in., inclusive and apply sealant to completely fill joint between manhole barrel and flexible connection for the full thickness of the manhole barrel.

E. Plug lift holes and repair any defects in manhole.

F. Set adjusting rings in Portland cement mortar bed.

1. Rings will not be required outside of paved roadways or walkways unless called for on the Contract Drawings.

2. Rings in paved roadways or walkways shall permit upward or downward adjustment of manhole frame by six inches.

G. All manhole frames shall be set on a bed of butyl mastic and bolted down with a minimum of 4 -5/8” stainless steel anchor blots. Anchor bolts shall be embedded a minimum of 4” into concrete.

3.13 Road/Highway Crossings

A. Where crossing is to be installed beneath a Commonwealth of Virginia road or highway, all operations and materials shall conform to the requirements of the Virginia Department of Transportation governing such crossings, and the contractor shall obtain approval of all materials and methods to be employed before such work is started. A copy of such permission shall be filed with the Owner prior to starting the work. The contractor will also be required to furnish a release from the proper authorities before final acceptance of the work by the Owner. The contractor shall secure from the Department of Transportation the necessary information regarding proper bracing, sheeting, shoring and other required protection of the highway and traffic during the construction operation.

B. Where an open cut is permissible in crossing the State Highway instead of boring, the contractor shall make the necessary provisions for handling traffic and replacing the roadbed and surface as required by the Virginia Department of Transportation.

3.14 Setting Valves and Valve Boxes.

A. Install valves with operator stems plumb in the vertical plane. Locate valves where shown on Drawings.

B. Equip all underground valves with valve boxes or standard precast concrete manholes where shown on the Drawings. Set valve boxes or manholes in accordance with drawings. Set box plumb in the vertical direction in alignment with valve stem centered on valve nut. Where valve boxes or manhole covers are used, set the valve box to prevent transmitting shock or stress to the valve. Set the box cover flush with the finished ground surface or pavement. PVC extensions shall not be permitted.

~~3.15 Testing~~

~~A. Pressure Testing of Water Mains and Pressure Pipe~~

~~1. Hydrostatic testing shall be performed in accordance with AWWA C600.~~

~~2. After the pipe has been installed, all pipe or any valved section thereof shall be subjected to a hydrostatic pressure of at least 1.5 times the working pressure or 150 psi whichever is greater, at the lowest point in the system.~~

~~3. Test Pressure Restrictions:~~

~~a) Test pressures shall:~~

~~i. Not be less than 1.25 times the working pressure or 125 psi whichever is greater at the highest point along the test section.~~

~~ii. Not to exceed pipe or thrust restraint design pressures.~~

~~iii. Be of at least 2-hour duration.~~

~~iv. Not vary by more than 5 psi for the duration of the test.~~

~~v. Not to exceed the rated pressure of the valves, hydrants and appurtenances.~~

~~b) Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of the lowest point of the line or section under test and corrected to the elevation of the test gage, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Owner's Representative.~~

~~c) Before applying the specified test pressure, air shall be expelled completely from the pipe, valves and hydrants. If permanent air vents are not located at all high points, the Contractor shall install corporation cocks at such points so that the air can be expelled as the line is filled with water. After all the air has been expelled, the corporation cocks shall remain closed and be left in place.~~

~~d) All exposed pipe, fittings, valves, hydrants, and joints shall be examined carefully during the test. Any damaged or defective pipe, fittings, valves, or hydrants that are discovered following the pressure test shall be repaired or replaced with sound material and the test shall be repeated until it is satisfactory.~~

~~B. Leakage Test For Bell and Spigot and Mechanical Joint Pipe~~

~~1. A leakage test shall be conducted concurrently with the pressure test~~

~~2. Leakage shall be defined as the quality of water that must be supplied into the newly installed pipe, or any valved section thereof, to maintain pressure within 5 psi of the specified test pressure after the air in the pipeline has been expelled and the pipe has been filled with water. Leakage shall not be measured by a drop in pressure in a test section over a period of time.~~

~~3. No pipe installation will be accepted if the leakage is greater than that determined by the following formula:~~

$$L = \frac{SD\sqrt{P}}{133{,}200}$$

in which L is the allowable leakage, in gallons per hour; S is the length of pipeline tested, in feet; D is the nominal diameter of the pipe, in inches; and P is the average test pressure during the leakage test in pounds per square inch gage.

4. When testing against closed metal-seated valves, an additional leakage per closed valve of 0.0078 gallons/hour/inch of nominal valve size shall be allowed.
5. Acceptance shall be determined on the basis of allowable leakage. If any test of pipe installed discloses leakage greater than that specified above, the Contractor shall, at his own expense, locate and make repairs as necessary until the leakage is within the specified allowance. ALL VISIBLE LEAKS ARE TO BE REPAIRED REGARDLESS OF THE AMOUNT OF LEAKAGE.

C. Leakage testing of exposed and above ground pipe

1. ALL JOINTS ARE TO BE WATERTIGHT. THERE SHALL BE NO VISIBLE LEAKS ALLOWED. ALL LEAKS ARE TO BE REPAIRED.

3.16 Flushing

1. **All mains shall be flushed in accordance with NFPA 24-2010 NFPA 13-2007 and NFPA 22-2003 requirements.**

3.17 Testing

A. **Pressure Testing of Water Mains and Pressure Pipe**

1. **Hydrostatic and leakage testing shall be performed in accordance with NFPA 24-2010 NFPA 13-2007 and NFPA 22-2003 requirements, including (but not limited to) the minimum 200 psi test pressure.**

END OF SECTION 02510